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ABSTRACT

This study investigated ways of using computer-based learning activities to complement curriculum practices in preschool programs with an early intervention component through the use of computer-based learning activities. Particular attention was given to supporting the development of young children's early mathematical skills. The study took place in a preschool center in the Illawarra region of New South Wales that served at-risk children and families in crisis. The focus of the study was on teaching methodologies and learner experiences that were likely to develop the skills necessary for successful integration into formal schooling. Participants were 11 students (6 in the experimental group and 5 in the control group) who had difficulty in using language fluently and effectively in a range of situations; were unable to persevere with tasks and activities; lacked purposefulness, imagination, and variety in play; lacked initiative; and lacked normal social skills and emotional maturity. Children in the experimental group took part in 7-12 sessions at a computer over a 6-8 week period. Total computer time ranged from 140 to 240 minutes. Paired control group subjects had access to nonmathematical computer-based activities. Findings indicated that experimental group subjects gained dramatically and significantly in mathematical skills and understanding. Appendices include the pretest and posttest, descriptions of software used in the study, and criteria for evaluating early childhood software.
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AN EVALUATION OF COMPUTER BASED ACTIVITIES IN AN EARLY INTERVENTION PROGRAM

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A report to the Early Special Education Program.
Department of Employment, Education and Training

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Executive Summary

- Early intervention** The aim of the project reported in this document was to investigate ways of complementing existing curriculum practices in preschool programs with an early intervention component through the use of computer based learning activities. In particular the project focussed on ways of supporting young children's development in the area of early mathematical skills. The research focussed on teaching methodologies and learner experiences likely to develop those skills necessary for successful integration into formal schooling.
- Computers** The role and potential of computer based technologies to enhance educational programs for primary and secondary students who experience cognitively based learning difficulties and disabilities of various kinds is increasingly well known. There is little understanding though of ways in which computer based activities might support and enhance the teaching and learning process for preschool aged children who are considered to be *at risk*.
- Structured teaching** Of this group of young children many are enrolled in some form of centre based *early intervention program*. Fundamental to the philosophy of such programs is the assumption that early detection and early stimulation offer good possibilities for enhancing children's growth and development. While there are a number of approaches to the teaching and learning process in these settings there is widespread agreement about the importance of structured teaching as a component of an early intervention program.
- Mathematics** Structured teaching refers to a situation in which children are guided and supported through a learning experience. There is an emphasis on certainty and predictability so that a child gains confidence in a given situation. Teaching sessions are usually limited to about 15 to 20 minutes.
- Mathematics** Mathematics in early childhood education is concerned largely with number and shape activities. But this labelling hides the wider range of experiences that young children require prior to beginning formal schooling. Most of these experiences are essentially pre-mathematical in nature.
- Methodology** Not all children will develop the necessary pre-mathematical knowledge from the informal mathematical and pre-mathematical activities inherent in day to day preschool experiences. For children identified as being at risk of experiencing learning difficulties in the early years of education the need to monitor the development of pre-mathematical experiences is very important.
- Methodology** The study employed a *pretest posttest control group design* and was conducted in a preschool centre in the Illawarra region of New South Wales that catered for children at risk and families in crisis. Children at the centre typically come from families in crisis who have presented at or been referred to support agencies for help. The 11 children involved in the study manifested some or all of the following behavioural characteristics.

Difficulty in using language fluently and effectively in a range of situations;

Inability to attend to and persevere with tasks and activities;

Lack of purposefulness, imagination and variety in play;

Lack of initiative; and

Lack of "normal" social skills and emotional maturity.

A pretest was developed to measure children's existing understanding of mathematical skills and concepts. A parallel posttest was also developed.

Pretests were administered individually and children were paired on the basis of test scores. One child from each pair was then randomly assigned to a group that had access to a series of computer based mathematical activities and the other to a group that had access to non-mathematical computer based activities. Six children were assigned to the experimental group and five to the control group. Children in the experimental group participated in from seven to twelve sessions at the computer for a total amount of time ranging from 140 minutes to 240 minutes, over a period of six to eight weeks.

An important focus of the research was on the identification and evaluation of readily available computer based activities that could support the learning of mathematics. A wide range of commercially available software was examined, but only software items which supported specific aspects of early mathematical learning was selected for use in the study.

Another important objective of the research was to provide guidelines for teachers who wanted to use computer based activities in working with children identified as being in need of early intervention. It was thus intended to create a situation approximating that which might be found in a typical early childhood centre that catered for children in need of specific intervention in a particular learning area.

Results

The significant outcome of this research is that the children exposed to computer based mathematical experiences gained dramatically in their mathematical skills and understandings. The posttest results showed that both groups scored more highly than in the Pretest. This may be explained in many ways, for example the pretest itself was an educative experience, the children had matured over the period of the experiment, and the non-computer classroom activities had increased their mathematical understandings. But where the gain for the non-computer children was in the order of 18%, the gain for the computer/experimental group was 50%.

Recommendations

- 1 Computer based learning activities have a role in preschool early intervention programs.
- 2 Commercially available software is suitable for use in these intervention programs.
- 3 Careful selection of educational computer software is essential.
- 4 The presence of an adult during the computer based learning activities is essential if children are to gain the most educational benefit from their experiences at the computer.
- 5 A high level of structured teaching which provides children with guidance, certainty and predictability is available through the careful selection of software, the careful planning of the teaching content while at the computer, and through the presence of an adult during the computer work.

1 BACKGROUND TO THE STUDY

1.1 Introduction

The role and potential of computer based technologies to enhance educational programs for primary and secondary students who experience cognitively based learning difficulties and disabilities of various kinds is increasingly well known. There is little understanding though of ways in which computer based activities might support and enhance the teaching and learning process for preschool aged children who appear to be experiencing early signs of learning difficulty.

The aim of the project reported in this document was to investigate ways of complementing existing curriculum practices in preschool programs with an *early intervention* component through the use of computer based learning activities. In particular the project focussed on ways of supporting young children's development in the area of early mathematics.

1.2 Computers and Early Childhood Education

Interest in the use of computers in early childhood education has increased rapidly over the past decade (Clements, 1987; Brady and Hill, 1984; Hinitz, 1989). Studies show that computers are well accepted by children in early childhood classrooms (Anselmo and Zinck, 1987; Clements, 1987; Elliott and Hall, 1985; Tan and Adams, 1984; Williams, 1984), and despite some early concerns that children may have difficulties in using computers from a technical viewpoint (Brady and Hill, 1984) the literature presents a clear picture of children's confidence and enthusiasm as they approach computer based learning experiences. Across the board, the impact of computer applications on children's learning in preschool is generally viewed as positive (Dewsbury, 1988).

Educators and researchers seem to be in general agreement about the ways in which computer based learning activities should be incorporated into regular preschool classrooms. The literature reveals that most computers in preschools are set up in learning centres and children choose to play in the *computer corner* just as they would choose to play in any other area.

Studies that have looked at patterns of social interactions when computers are used have found that children engage in a considerable amount of interactive and cooperative behaviour in the computer area (Blemings, 1985, 1989; Elliott, 1987; Elliott and Hall, 1985; Lipinski et al, 1986; Swigger, Campbell and Swigger, 1983; Swigger and Swigger, 1984; Warash, 1984; Ziajka, 1983). The promotion of opportunities for social interaction is considered central to preschool curricula because of its critical role in cognitive development.

A number of studies which have looked more specifically at the development of early academic skills and concepts through participation in computer based activities have shown similar indications of positive outcomes for young children. Hines (1983) found that of the five kindergarten children she studied all increased their number and letter recognition skills, their understanding of spatial concepts and number quantity, their ability to perform Piagetian tasks and their understanding of and attitudes toward computers. Piestrup (1981, 1982) also found that preschoolers increased their knowledge of the concepts *right*, *left*, *above* and *below* after participation in computer based activities designed to develop these concepts over a three week period. Studies by Smithy-Willis, Riley and Smith (1982), Casey (1984) and Prinz, Nelson and Stedt (1982) found similar gains in more language oriented areas. Smithy-Willis, Riley and Smith (1982) report that the six preschoolers in their study showed significant improvements in their ability to discriminate letters after using a visual discrimination program, Casey (1984) found improvements in five year olds' language and print production and Prinz, Nelson and Stedt (1982) who worked with ten deaf preschoolers on computer based activities designed to develop beginning reading concepts and skills, noted significant improvements in children's scores on tests of word recognition and identification. They claim that some computer-based teaching programs are very effective in helping children develop these skills. In one study which focused specifically on preschool aged children's language as well as broad social development, it was found that "language activity measured as words spoken per minute was almost twice as high at the computer" as at any of the other regular classroom activities (p. 6). The other activities were playdough, blocks, art with colouring pens and a fishing game (Muhlstein and Croft, 1987).

There are some indications that active teacher involvement may have a critical effect on the quality of young children's learning in the computer area. Several studies in both preschool and kindergarten classes have found that when teachers worked with children in computer based activities by encouraging, praising, questioning, responding, prompting and modelling, children were successful in achieving desired

goals (Clements, 1986; Shade and Watson, 1987). It has been suggested that children seem more interested and attentive to computer based tasks and display less frustration and aggression when an adult is present in the computer area (Binder and Ledger, 1985; Shade et al., 1986; Anselmo and Zinck, 1987).

Despite the mounting evidence to suggest that many computer based learning experiences can support traditional learning experiences for young children in regular preschool programs, only recently has it been acknowledged that computer based technologies and computer based activities have the potential to make a useful contribution to curricula for preschool children who exhibit early indications of learning difficulties. There is little information though on whether applications of computer based technologies in these situations can in fact have positive impacts on learning and development (McMurtie, 1989).

1.3 Computers and Special Education

The notion that computers and related technologies have applications and benefits in educational settings catering for children and adults who have a physical handicap is well accepted. Through the use of a range of input and output devices, for example a light wand directed by head movements, a learner is able to interact with a computer and so participate in a range of activities that would otherwise be unavailable. Learning activities available to a student by these means include music and painting, writing through a word processor, and a range of social science, scientific and creative problem solving experiences. Limitations of access to possible learning activities are related to software availability rather than a student's inability to interact with the computer because of a physically handicapping condition. Touch screens, concept keyboards, button boxes, large text sizes and speech capable software are other devices currently available to learners unable to use a keyboard.

In recent times a growing interest in the role of computer based technologies in enhancing educational programs for students who experience cognitively based learning difficulties and disabilities of various kinds has developed. Indeed it is increasingly acknowledged that computers and related technologies can have far reaching applications and benefits in such programs (Budoff and Hutten, 1982; Hagen, 1984; Kolich, 1985; Yin and Moore, 1987; Pollard, 1984; Pryce-Davies, 1987; Williams, 1986). There are very few studies though that have extended this idea to investigations of the role and potential for computer based technologies and computer based learning activities to support and enhance the teaching and learning process for

preschool aged children who exhibit behaviours consistent with aspects of developmental delay, who are considered to be at risk, or who are identified as presenting early signs of learning difficulty.

Of this group of young children many are enrolled in some form of centre based *early intervention program*. Fundamental to the philosophy of such programs is the assumption that early detection and early stimulation offer good possibilities for enhancing children's growth and development (Rees, 1989). While there are a number of approaches to the teaching and learning process in these settings there is widespread agreement about the importance of *structured teaching* as a component of an early intervention program.

Structured teaching refers to a situation in which children are guided and supported through a learning experience. Teaching strategies include direct imitation, modelling, turn taking, role reversal and attention to repetition. There is an emphasis on certainty and predictability in the patterns of interaction so that a child gains confidence in a given situation. Teaching sessions are usually limited to about 15 to 20 minutes (Rees, 1989). Supporters of structured teaching argue that teacher guidance will lead to self initiated and self mediated performance.

Preschool programs typically involve children in self selecting activities, and a number of studies using computers in preschools have been based on this idea of self selection. In these settings the computer is seen simply an activity like water play or block play (Elliott and Hall, 1985) and children decide if and when they will "play" with the computer. In programs which contain an emphasis on structured teaching, computer based activities can be used to complement and support this approach to the teaching process. As Williams (1986) emphasised, computer based activities lend themselves to implementation in a structured learning environment because of their multisensory orientation, their interactive and motivational qualities, their facility for reinforcement of concepts, and their ability to simplify tasks into manageable steps. Indeed, the predetermined and sequential structure of many computer programs, together with their engaging graphics, animation, sound and colour capabilities provides an excellent setting to enhance the teaching and learning process. The benefits of such a setting are twofold: first the motivational qualities inherent within the program can serve to help the learner focus attention on the activity at hand; secondly, the teacher now freed from some of the managerial tasks typical of a structured teaching situation can concentrate on encouraging, pointing, questioning, probing and guiding the child.

1.4 Mathematics Education

Mathematics in early childhood education is concerned largely with number and shape activities. But this labelling hides the wider range of experiences that young children require prior to beginning formal schooling. Most of these experiences are essentially pre-mathematical in nature, that is, their acquisition helps later learning in the more formal mathematics generally associated with the first years of school. The corollary to this is, if children begin formal schooling without the necessary pre-mathematical experiences they may well find learning mathematical concepts and skills difficult. They will especially be disadvantaged in comparison with children who have participated in a broad range of mathematical experiences in either formal or informal settings.

Matthews and Matthews (1978) proposed that pre-mathematical experiences suitable for early childhood education centred around activities involving sorting, ordering, matching, comparisons, shape recognition, spatial ordering and topology. They further suggested that these activities were not meant to be taught in formal instructional contexts, and were not meant to inhibit the natural creativity and curiosity of young children as they explored their environment. That these activities are often inherent in the day to day activities of preschools and infants schools is well known. Indeed it is frequently argued that teachers need only to direct learners' attention more intentionally to the pre-mathematical aspects of their work in order to draw out the mathematical relationships that are present in whatever activities are being pursued. In a typical preschool setting aspects of activities such as water and sand play, the home corner, outdoor play, blocks and games, rhymes and stories are all able to engender mathematical experiences. That children will absorb all the necessary pre-mathematical knowledge from such experiences is debatable unless there is a high degree of teacher intervention to guide learning and to encourage the establishment of cognitive relationships.

An example of a typical preschool activity in which children are exposed to mathematical skills and concepts is the chanting and singing of various nursery rhymes related to counting. Rhymes and songs such as *Ten Green Bottles*, *One, Two Buckle my Shoe*, *This Old Man and One Potato, Two Potatoes* present opportunities in which children can learn the names of numbers and their counting order. Similarly the use of building and construction materials, such as blocks and cardboard boxes help children develop concepts of shape, size and order, and are generally recognised as providing opportunities for the development of pre-mathematical activities.

The opportunities for a number of other typical preschool activities to provide mathematical experiences are less well known. Water play for example provides many instances for children to deal with comparisons, *larger, smaller, above, below, next to, inside and outside*. Such concepts are essential to mathematical development. So water play not only provides opportunities for the use of language and the development of social skills such as sharing, but is a valuable setting for the development of mathematical knowledge. Similarly the home corner, can become a valuable context for mathematical experiences: *We need one cup for each person, how many cups? And we need one saucer for each cup. Where do we place the cups and saucers? Where do we put the plates, the knives and forks? What patterns are possible? What shape are the plates? What shape is the table? How many chairs will we need? How many slices of cake? How will we cut the cake equally?*

All children need a range of pre-mathematical experiences before entering school. Not all children though will develop the necessary pre-mathematical knowledge from the informal mathematical and pre-mathematical activities inherent in day to day preschool experiences. For children identified as being at risk of experiencing learning difficulties in the early years of education or exhibiting characteristics typically associated with *developmental delay* the need to monitor the development of pre-mathematical experiences is very important. Generally such children will need more and different opportunities than their peers to develop the pre-mathematical concepts, skills and language necessary for early academic success. Unfortunately for these children poorly developed pre-mathematical concepts and skills are likely to make learning more difficult for them than for their peers. The reality is that teachers in the first years of school are generally unable to provide individualised learning programs for children. Children who are performing "below the norm" are quite likely to have difficulty in keeping up with their peers in regular classroom activities. Nowhere is this more likely to be the case than in mathematics.

1.5 Issues of Concern

For those children identified as being at risk of experiencing learning difficulties in the early years of education or exhibiting characteristics typically associated with developmental delay, a good foundation on which to build early skills in mathematics is especially important to academic success in the first years of school.

Our belief is that children who may experience difficulty in learning pre-mathematical skills and concepts should receive specific help in this area by a more focussed exposure to these concepts and skills at the preschool level. In particular, practice in number and shape activities should give them a sound basis from which to tackle their early school pre-mathematical and mathematical experiences.

It is the issue of helping young children to develop the early experiences necessary for successful integration into school that is the concern of the research reported in this document. More specifically, the research sought to explore the role of computer based learning activities in supporting more traditional approaches to the teaching and learning process. In particular the research addressed the questions:

What types of computer based learning activities can enhance learning opportunities for preschoolers who are at risk or who exhibit early signs of experiencing learning difficulties?

Can specific computer based activities facilitate aspects of pre-mathematical development in a preschool classroom setting?

What is an appropriate way for early childhood teachers to introduce computer based learning activities to preschoolers who are at risk or who are experiencing early signs of learning difficulties?

The above questions were formulated from the specific objectives as specified in the original research proposal. The specific objectives are stated below.

To identify and evaluate items of early childhood computer software in terms of the potential to support the cognitive and affective learning of children with identifiable developmental delays enrolled in preschool or kindergarten classes;

To identify classroom management and teaching strategies which facilitate the introduction of computer based learning activities to children with identifiable developmental delays in preschools and kindergartens;

To make recommendations about the appropriateness of selected early childhood software (and associated hardware) to support the cognitive and affective learning of children with developmental delays in the broad curriculum areas of expressing, communicating and investigating;

To make recommendations about procedures for introducing computer based learning activities in terms of classroom management and teaching strategies;

To produce two documents: a research report including recommendations and a practical handbook for teachers.

After assessing the situational needs and constraints of the setting in which the study was to take place it was decided to focus the research on ways of facilitating the early mathematical development of children within the centre. Mathematics was selected for a number of reasons. First, the centre already had a clear and well developed language enrichment program and was planning to further develop that program with support of computer based activities¹. Secondly, as discussed above, there is the clear recognition that young children need good pre-mathematical knowledge and understandings in the first years of school, yet there is a far less concerted emphasis on its development within the preschool classroom. Indeed there is considerable evidence that early childhood teachers while confident and happy when dealing with social and language development, are less confident in the field of mathematics. While there is a range of resource material available to preschools to assist young learners in gaining pre-mathematical skills, both the materials and strategies for implementation are often not well known. Hence, mathematics is an area in which teachers often feel the need for additional expert input. Indeed the preschool in which the study took place identified itself as one which focused on language development, perhaps at the expense of mathematical development.

¹ Susan Lee Walker a post graduate student within the Faculty of Education at the University of Wollongong was about to embark on a project designed explore the use of computer based activities to support language development as part of the requirements for her M.Ed. degree.

2 METHODOLOGY

The study employed a *pretest posttest control group design* and was conducted in a preschool centre in the Illawarra region of New South Wales catering for children at risk and families in crisis. Prior to the commencement of the project permission was sought from families for children to take part in the study.

2.1 Selecting Software

An important focus of the research was on the identification and evaluation of computer based activities that could support the learning of mathematics, that were readily available through commercial outlets. The decision to use commercial software was based on the belief that it is unrealistic to expect teachers and others associated with preschools, or indeed schools in general, to create their own software. In order to use computer based activities then, there is little alternative but to acquire commercially available software. Generally these materials must be obtained locally because of the limited resources and time available to most early childhood educators. Rarely is it possible for teachers to seek materials from overseas sources. Sometimes it is even difficult to obtain materials from interstate. It was important then to trial only that software which was easily obtainable through local software distributors.

A wide range of commercially available software was examined. The researchers were familiar with a good deal of the software, but additional items were studied and evaluated. Figure 1 provides details of the criteria used to analyse the mathematical components of each item of software. The fields selected, such as *counting*, *sorting*, *patterns* and *shapes*, were based on an understanding of the major areas of early mathematical learning. Only software items which supported learning in these areas was selected for use in the study. Procedures for evaluating and selecting appropriate software are provided in Appendix 3.2 of this report and in the teachers' booklet which accompanies the report.

Figure 1

Skills, processes, concepts evident
in software items used in study

Software Item**	1	2	3	4	5	6	7
Skill							
counting	*		*	*	*	*	
one to one correspondence	*		*	*	*	*	
money							
sorting					*		
weighing/measuring							
left and right							
shapes		*			*	*	
colours		*					*
comparisons (larger/smaller, more than/less than)	*				*		*
matching	*	*	*		*	*	
patterns	*	*			*	*	
number names	*		*	*	*	*	
invariance (word, numeral)	*		*	*	*	*	
seriation/order	*	*	*		*		
grouping (sets)	*		*	*	*	*	
cardinal numbers	*		*	*	*	*	
ordinal numbers							
spatial relations		*			*	*	

** 1. Number Farm
4. Sticky Bear Numbers
7. Opposites Attract

2. Colour Shape Rodeo
5. Math & Me

3. Charlie Brown's 123
6. Early Games

An analysis of the full range of mathematics software available to the researchers resulted in some items being rejected for the purpose of this study because of unsuitability of content, language or overall presentation. Others were rejected on purely logistic grounds: that is, only a small number of software items could actually be used given the time frame of the study.

It is important to note that software was selected on the basis of identifiable needs of the children in terms of mathematical learning and curriculum orientation. What was considered appropriate in this setting may not be appropriate in another setting or with other children. It is essential to evaluate and test items of software before using them with a child or group of children.

2.2 Planning for Teaching

An important objective of the research was to provide guidelines for teachers who wanted to use computer based activities in working with children identified as being in need of early intervention. That is the research was to be used as a basis for providing teachers with ideas for introducing computer based learning activities to preschoolers who were part of an early intervention program. It was considered important then to conduct the study in as realistic setting as possible, taking into account existing resources, the constraints of day to day centre management and organisation, and philosophical orientations toward curricula and the teaching and learning process.

In order to maintain the continuity of the curriculum and existing teaching and learning strategies within the centre, and in particular the belief that children would work best in a structured learning situation, it was decided that children should work on computer based activities in pairs with the guidance and support of a teacher. To facilitate this approach the computer was set up in a quiet part of the centre away from major noise and traffic flow. It was thus intended to create a situation approximating that which might be found in a typical early childhood centre that catered for children in need of specific intervention in a particular learning area.

2.3 The Preschool Context

The children who participated in this study attended an early childhood centre in the Illawarra region which provides integrated services for children at risk and families in crisis. Here the term *at risk* refers to a situation in which children's environments are seen to be hindering and delaying their normal development. *Environments* include physical and human elements, and extended from the antenatal period through to the present time.

Children at the centre typically come from families in crisis who have presented at or been referred to support agencies for help. In most cases the children's life experiences do not contain the patterns and consistency of interactions with material and social environments that are generally considered essential to "normal development". In the

context of this project the terms "at risk" and "developmental delay" were used to suggest the existence of conditions that posed a significant difficulty to the child's development of social and communication skills (Foulks and Morrow, 1989; Slavin and Madden, 1989, Rees, 1989). Centre based records indicated that children involved in the study manifested some or all of the following behavioural characteristics. Some of these characteristics are consistent with the notion of developmental delay.

Difficulty in using language fluently and effectively in a range of situations;

Inability to attend to and persevere with tasks and activities;

Lack of purposefulness, imagination and variety in play;

Lack of initiative; and

Lack of "normal" social skills and emotional maturity.

Of particular concern is that children attending the centre may be predisposed to experiencing learning problems in the the first years of school. To this end a major goal of the centre is to intervene in ways that will help preclude the later development of learning problems at school. It was hypothesised that computer based learning activities might provide new opportunities for learning, and so help children cope better with their early learning encounters in the first years of school.

2.4 The Research

The research reported here aimed to investigate whether selected commercially available computer based activities could be used to assist *at risk* children in the acquisition of specific mathematical concepts and skills. In order to provide an indepth analysis of children's interactions with selected computer based activities, and of teaching and classroom management strategies, the study was conducted with a small group of children in a naturalistic setting.

2.5 Subjects

The subjects were a group of ten (originally eleven) children enrolled in an early intervention program in the Illawarra region of New South Wales. Children were selected because it was their last year in preschool before commencing primary schooling.

2.6 Procedure

The study employed a modified *pretest posttest control group design* in a naturalistic setting, supported by observational and case study material. The aspect of the study reported here relates to the specific gains in mathematical knowledge as measured after participation in computer based activities. Some details of observational and case study material that illustrate important aspects of children's experiences are also provided in this section.

Prior to the commencement of the study all children participated in a range of non-mathematical activities involving the computer. The purpose of this was to avoid possible novelty effects associated with the computer. Generally two to three children worked at the computer with a teacher for periods of about fifteen minutes. These sessions were repeated so that each child spent a total of about one hour at the computer.

A pretest consisting of ten items with a total of 80 sub items was developed to measure children's existing understanding of mathematical skills and concepts. Six items were concerned with counting and numeration, two items asked questions about shapes, and two items sought answers about comparisons of numbers. The items that involved counting used concrete materials, jelly beans and the like, which children were allowed to keep. A copy of the pretest is provided in Appendix 1. Pretests were administered individually and children were paired on the basis of test scores. One child from each pair was then randomly assigned to a group that had access to a series of computer based mathematical activities and the other to a group that had access to non-mathematical computer based activities. Six children were assigned to the experimental group and five to the control group. One child from the control group left the preschool shortly after the commencement of the study reducing the size of this group to four.

In order to maintain the continuity of the curriculum and existing teaching and learning strategies within the centre, and in particular to reflect the belief that a structured teaching approach is beneficial for the child at risk (Rees, 1989), the computer based activities were organised so children worked in pairs with the support and guidance of a teacher for a set period of time, on a set number of occasions. Activities were carefully selected to meet the predetermined learning needs of individuals in the area of mathematics.

Children in the experimental group participated in from seven to twelve sessions at the computer for a total amount of time ranging from 140 minutes to 240 minutes, over a period of six to eight weeks. The composition of the pairs varied from day to day depending on attendance and participation in other activities. Children in both the experimental and control groups participated in all other preschool activities, including mathematical activities. These mathematical activities were pre-mathematical in nature and were based on everyday incidents and routines such as setting tables for lunch and distributing fruit; pre-mathematical experiences were inherent in many play activities such as sand and block play. Such activities were quite different from the content of the computer software.

Five items of mathematical software were selected from a range of locally available commercial software: *Number Farm*, *Charlie Brown's 123's*, *Sticky Bear Numbers*, *Math and Me*, and *Early Games*. These software items focussed on number, numeral and shape recognition, and comparison activities.

At the conclusion of the experimental period a posttest designed to measure the same mathematical skills and concepts as measured by the pretest was administered to all ten children. Each item in the posttest was parallel to an item in the pretest. A copy of the posttest appears in Appendix 2.

3 RESULTS

Qualitative analyses

The computer based mathematical activities proved to be popular amongst children in the experimental group. They enjoyed participating in the activities and responded well to the structured teaching approach. It needs to be noted though, that despite children's interest in the idea of using the computer and the engaging presentation of the computer based experiences teacher involvement in the management of the sessions was essential. Most children needed constant support and encouragement in order to sustain their participation in the tasks at hand. Constant help was required for children to remember the sequences of instructions or commands needed to interact with the activities. Given the nature of the behavioural characteristics of the children, especially perceived problems in selective and sustained attention, purposeful participation in early academic tasks without the involvement of a teacher is difficult.

The pretest indicated that children tended to have difficulty with rote counting, the idea of one to one correspondence when counting objects in sets, especially those containing more than four items, naming shapes, and recognising and naming numerals. They were generally successful at matching shapes. Individual activities within the selected software packages focussed on providing structured settings in which children could explore mathematical concepts and use skills related to these areas.

Case study records for each child show gradual progression in confidence as a computer user and as a participant in a small group learning situation, an increasing use of language to communicate about thoughts and actions, and developing competence in the mathematical skills and understandings required by the activities. Material from the case study record of subject E3 illustrates the nature of development in these areas. E3 was a five year old child from a very difficult and disruptive family background. E3 had difficulty with expression in normal conversational situations, lacked self confidence and sought constant reassurance from adults for actions and intended actions. E3's lack of overall maturity, language difficulties, emotional problems and poor performance in the initial test of mathematical knowledge and skills (49/80) suggested potential difficulty with mathematics in the first years of school.

At first E3, despite being very keen to use the computer, had difficulty in concentrating on the task at hand and required constant teacher support and encouragement to work through an activity. The most obvious characteristic of E3's behaviour in the computer activities was a lack of confidence and the constant seeking of reassurance from the teacher. Language was used mostly for seeking confirmation of intended or completed actions or negotiation about turn taking.

By the end of the experimental period E3 was showing a much greater ability to persevere with specified activities and to use language to communicate about thoughts and actions related to the task at hand. Importantly, E3 seemed to display much more confidence as a participant in the computer activities and was more prepared to take actions without seeking teacher reassurance. Of special interest to centre staff was the ways in which this renewed confidence seemed to be reflected in other behavioural spheres. This improved confidence was accounted for in two ways: first, natural maturity over the eight week period, and secondly, the ability of E3 to be overtly successful in a series of carefully structured and controlled activities. Because of teacher intervention there was little opportunity to make mistakes and correct answers were rewarded by animated graphics and sound. By the end of the experimental period E3 was able to execute the command sequences necessary to interact with the software with some teacher help and seemed especially pleased to have developed the skill to use the computer successfully.

In addition to evidence of overall development in the use of language and self confidence, E3's gains in mathematical knowledge were dramatic, with a gain score increase of 43%. Case study notes reveal that E3 increasingly counted objects accurately, improved her matching skills in respect of shapes and numerals, began to associate the numerals with sets, and improved her understanding of mathematical terms and concepts such as more than and less than. E3 also gained skill in following directions and remembering sequences of actions and became involved in solving mathematical problems even when her partner had the responsibility for controlling an activity. Case study notes report that the activities seemed to provide E3 "with the information and opportunity necessary to evaluate responses, then to either accept or change them. This appeared to have an empowering effect which has increased (E3's) self confidence, perseverance and attention and commitment to the task at hand".

Quantitative analyses

Scores on the pre and posttests were analysed in order to determine the effectiveness of the computer based activities on children's mathematical skills and knowledge. Table 1 presents the pretest, posttest and gain scores for the six subjects in the experimental group (E1 to E6) and for the four subjects in the control group (C1 to C4). It shows that the gain scores are higher for children in the experimental group than for children in the control group, with the greatest gain evident in the six arithmetic questions. The application of a Mann-Whitney test of significance on the differences in gain scores for the arithmetic questions and across the total range of test items indicates that in both cases the larger gain scores of the experimental group were significant at the 2% level.

Table 1
Children's pretest, posttest and gain scores

Child	Arithmetic questions Maximum score 60			All questions Maximum score 80		
	Pretest	Posttest	Gain	Pretest	Posttest	Gain
E1	51	60	9	68	79	11
E2	44	54	10	60	73	13
E3	34	52	18	49	70	21
E4	26	41	15	41	59	18
E5	25	41	16	39	60	21
E6	12	33	21	22	50	28
C1	46	42	-4	62	60	-2
C2	44	46	2	57	58	1
C3	18	21	3	29	38	9
C4	10	18	8	24	34	10

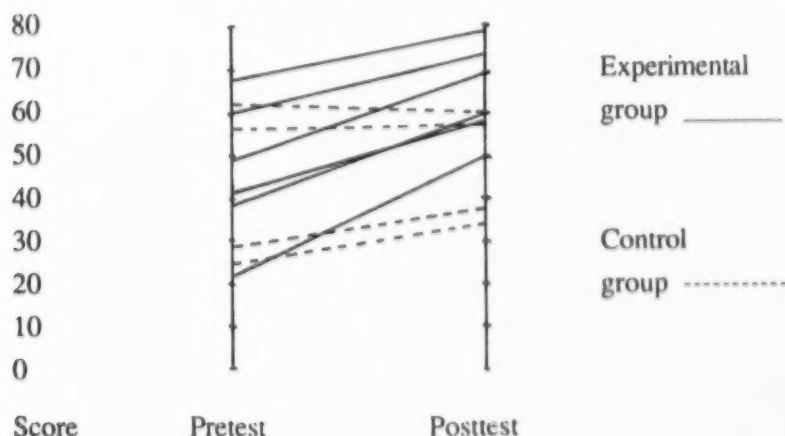
W = 45.0 p = .0142

W = 45.0 p = .0142

Test statistics are shown in Table 1. Overall, the children with access to the selected computer based mathematical activities had significantly greater gain scores on the posttest than did the children who used non mathematical activities. Scores are shown separately for the six arithmetic question and the total ten questions in order to distinguish between children's performance in activities focussing on numerals and counting and those involving shapes and comparisons.

Of the children in the control group the two subjects who scored quite well in the pretest changed their scores very little in the posttest. The two subjects who scored poorly in the pretest showed good gain scores in the posttest. These gains may have occurred because of participation in the preschool activities that focussed on mathematical learning through informal means, the presence of some mathematically oriented experiences in the seemingly non mathematical computer activities, mathematical experiences outside the centre, interaction with children in the experiemental groups, or simply through some kind of mathematical maturity. In every case though, the increases in the scores of the experimental group are greater than the changes to the scores of the control group. The change in scores between the pretest and the posttest is illustrated graphically in Figure 2. The slope of the lines for each subject indicates the rate of the increase: the greater the slope the greater the increase. Two comparisons stand out in the graph: the experimental group members who scored from 40 and 60 in the pretest all increased their scores markedly in the posttest, while the scores of the two control subjects in this range altered little. And while the two low scoring control group subjects also increased their scores, the rate of change was much lower than for the low scoring experimental group subject.

Figure 2
Pretest and Posttest Scores



A comparison of the average scores of the experimental and control group is presented in Table 2.

Table 2
Average pretest and posttest and
average gain scores (AGS) for all children

	Arithmetic questions (maximum score 60)			All questions (maximum score 80)		
	Pretest	Posttest	AGS	Pretest	Posttest	AGS
Experimental group	32	46.8	14.8 (65%)	46.5	65.2	18.7 (49.3%)
Control group	29.5	31.8	2.3 (18.3%)	47.5	43	4.5 (17.8%)

In the pretests the average scores of the two groups were equivalent for both the six arithmetic questions and for the total ten questions. The posttest scores indicate that subjects in the control group have had only small increases in scores, while there is a large increase between the pretest and posttest scores of the experimental group. This has resulted in the considerable difference between the posttest scores of the experimental group and the control group. Table 2 also presents average gain scores (AGS) across all test items. These indicate that the experimental group had much higher average gains than did the control group (14.8 versus 2.3 and 18.7 versus 4.5). On average the scores of children in the experimental group increased by 65% on the arithmetic questions as opposed to 18.3% for the control group. The scores of children in the experimental group also showed a larger increase (49.3%) than did the scores of children in the control group (17.8%) across all ten items.

4 DISCUSSION AND CONCLUSION

This study sought to investigate the potential for readily available computer based mathematical activities to support more traditional modes of teaching mathematics in an early intervention preschool program. Results indicate that computer based activities can be used successfully as an integral part of an early intervention program and that children seem to both enjoy and benefit from their involvement in the activities. Specifically, the findings illustrate that children's participation in selected computer based mathematical activities in a structured teaching and learning situation can bring about significant changes in their achievements in tests of mathematical skills and concepts. The commercial software selected for use in the study seemed to provide a relevant, interesting and engaging setting for mathematical experiences. Children seemed comfortable using the computer and had little difficulty interacting with the software in a structured teaching situation.

The study was based on an understanding that the computer based experiences should occur within a structured learning environment. Within this environment the teacher played an active role in supporting and guiding children's interactions with the software and with each other. The study indicated that such an environment was an appropriate setting given developmental characteristics of the children and the educational goals of the mathematical activities. We would argue further that even in those educational computer applications which are more open ended in nature, such as problem solving games and art/drawing related activities, teacher involvement is critical if young children are to gain maximum benefit from the activity. Indeed, for computer based activities to promote the kinds of interactive and cooperative exchanges that facilitate learning in various domains it would seem that teachers need to exercise the same creative and dedicated attention to planning and implementation as they would for any other aspect of their teaching program.

The use of a computer as a teaching/learning resource to bring about positive changes to achievements in the learning of specific mathematical skills and concepts is supported by results gained by those children with access to computer based activities, who showed significantly higher gain scores from pretest to posttest than did children who did not participated in such activities. The study is not in any way suggesting

however that computer based activities provide the only means of improving early mathematical skills and abilities. Indeed, it may be that similar improvements would have occurred using other teaching materials and approaches: we are able to report solely on the success of the computer based approach.

While this study provides only a small contribution to the body of research needed to establish a clearer understanding of the nexus between individual learning needs, computer based learning experiences and curricula for the at risk child, its significance lies in establishing that computer based activities do have the potential to provide a useful teaching resource within the context of an Australian early intervention program. The study showed that participation in selected computer based activities seemed to increase children's mathematical knowledge and skill within a given context. The methodological limitations of the study indicate that caution must prevail in any attempt to generalise from these findings, but at the same time, the results provide encouragement for the notion that teachers, computers and curricula can become productive partners in specific educational programs that cater for young children with special learning needs.

That computers and related technologies have had a significant impact on the teaching and learning process in many programs catering for school aged children with special learning needs is well documented. That computer based activities might also provide new opportunities to support the special learning needs of preschoolers has been the subject of more recent investigation and speculation. Early indications of positive impacts on aspects of learning need to be explored more fully. And there is a growing need for research into ways in which the implementation of computer based activities might complement more traditional approaches to the teaching and learning process. Research projects that consider both pedagogical as well as management and training issues should have a high priority. In particular a major research emphasis should be on exploring ways in which certain types of computer based activities might best enhance the development of specific cognitive and social competencies within qualitatively distinct educational environments, including the home.

5 RECOMMENDATIONS

The following recommendations are based on experiences and findings from the study.

- 1 Computer based learning activities have a role in preschool early intervention programs.
- 2 Commercially available software is suitable for use in these intervention programs.
- 3 Careful selection of educational computer software is essential.
- 4 The presence of an adult during the computer based learning activities is essential if children are to gain the most educational benefit from their experiences at the computer.
- 5 A high level of structured teaching which provides children with guidance, certainty and predictability is available through the careful selection of software, the careful planning of the teaching content while at the computer, and through the presence of an adult during the computer work.

6 REFERENCES

- Anselmo, S. and Zinck, R.A. (1987). Computers for young children? Perhaps. *Young Children*, 42(3), 22-27.
- Beard, R. (1985). Children's language and literacy and the microcomputer, in MEP, *Infant and first schools: The role of the microcomputer*. London: MEP, 29-39.
- Binder, S.L. and Ledger, B. (1985) Preschool computer project report, Oakville, Ontario, Canada, Sheridan College. Cited in D. Clements, (1987), Computers and young children: A review of research. *Young Children*, 42(1), 34-44.
- Blemings, S. (1985). Computers in preschools in B. Rasmussen (Ed) *The information edge. The future of educational computing*. Brisbane: CEGQ.
- Blemings, S. (1989). *Microcomputers in Queensland preschools: Realities*. Brisbane: Department of Education.
- Brady E. and Hill, S. (1984). Young children and microcomputers: Research issues and directions. *Young Children*, 39(3), 41-61.
- Budoff, M. and Hutten, L. (1982). Microcomputers in special education: Promises and pitfalls. *Exceptional Children*, 49(2), 123-128.
- Casey, J.C. (1984). *Beginning reading instruction: Using the LEA approach with and without microcomputer intervention*. Paper presented at the Annual Meeting of the Western Regional Conference of the International Reading Association, Reno (ERIC Document No. ED 245 192).
- Church, G. and Bender, M. (1989). *Teaching with computers: A curriculum for special educators*. Boston: Little, Brown and Company.
- Clements, D.H. (1987). Computers and young children: A review of research. *Young Children*, 42(1), 34-44.
- Elliott, A. (1987). Computers in the preschool: Facilitating prosocial behaviours, in J.Hancock (Ed) *Tomorrow's Technology Today*. Proceedings of the Australain Computers in Education Conference, Adelaide, SACEG, 95-101.
- Elliott, A. and Hall, N. (1985). Computers in the preschool: Enhancing curriculum goals, in *Early childhood: Ideals and realities. (Vol 2)*. Brisbane: AECA, 372-386.
- Foulks, B. and Morrow, R.D. (1989). Academic survival skills for the young child at risk for school failure. *The Journal of Educational Research*, 82(3), 158-165.
- Hagen, D. (1984). *Microcomputer resource book for special education*. Reston, VA.: Reston.
- Hines, S.N. (1983). Computer programming abilities of 5 year old children. *Educational Computer Magazine*, 3(4), 10-12.
- Hinitz, B.F. (1989). Computers in early education in the USA: A review of current research. *Australian Journal of Early Childhood*, 14(3), 40-47.

- Katz, L.G. and Chard, S. (1989). *Engaging children's minds: The project approach*. Norwood, NJ: Ablex.
- King, N.R. (1986). Play and the culture of childhood, in G. Fein, and M. Rivkin, (Eds) *The young child at play: Reviews of Research* (Vol 4). Washington, DC.: NAEYC, 29-41.
- Kolich, E. (1985). Microcomputer technology with the learning disabled: a review of the literature. *Journal of Learning Disabilities*, 18(7), 428-431.
- Lipinski, J.M, Nida, R.E. Shade, D.D. and Watson, J.A. (1986). The effects of microcomputers on young children: an examination of free play choices, sex differences and social interaction. *Journal of Educational Computing Research*, 2(2), 147-167.
- Massey, C. and Gelormino, J. (1987). *The influence of a math software program on preschoolers' acquisition of mathematics: 'Ruton' in the classroom*. Paper presented at the Annual Meeting of the AERA, April, Washington, DC.
- Matthews, G. and Matthews, J. (1978). *Early Mathematical Experiences*. London: Addison-Wesley.
- McMurtie, G (1989). Communication, cooperation and computers-How computers fit into the daily routine of preschoolers with special needs, in T.Dupe (Ed) *ACEC89 Back up the future*. Proceedings of the Australian Computers in Education Conference, Canberra: ACTCEG, 161-168.
- Piestrup, A. (1981). *Preschool children use an Apple II to test a reading skills program*. (ERIC Document No ED 202 476).
- Piestrup, A. (1982). *Young children use computer graphics*. (ERIC Document No ED 224 564).
- Pollard, J.P. (1984) Understanding technology: Adaptive devices for special education. *Electronic Learning*, 3, 44-46.
- Prinz, PM, Nelson, K. and Stedt, J. (1982). Early reading in young deaf children using microcomputer technology. *American Annals of the Deaf*, 127, 444-461.
- Pryce-Davies, P.M. (1987). *Teaching learning and technology in special needs classrooms. A national information statement*. Canberra: Commonwealth Schools Commission.
- Rees, R. (1989). Early intervention and the development of communication skills. in C. Johnson (ed) *Communication in early intervention and A family systems approach to early intervention*. Proceedings of the Fifth (1987) and Sixth (1988) Early Intervention Conferences of the NSW Early Intervention Association. Sydney: NSW Early Intervention Association.
- Shade, D.D., Nida, R.E., Lipinski, J.M. and Watson, J.A. (1986). Microcomputers and preschoolers: Working together in a classroom setting. *Computers in the Schools*, 3, 53-61.
- Slavin, R.E. and Madden, N.A. (1989). What worked for students at risk: A research synthesis. *Educational Leadership*, 16, 4-13.

- Smithy-Willis, D., Riley, M.T. and Smith, D. (1982). Visual discrimination and preschoolers. *Educational Computer Magazine*, 2(6), 19-45.
- Swigger, K., Campbell, J. and Swigger, B. (1983). Preschool children's preferences for different types of CAI programs. *Educational Computer Magazine*, Jan/Feb, 38-40.
- Swigger, K.M. and Swigger, B.K. (1984). Social patterns and computer use amongst preschool children. *AEDS Journal*, 17(3), 35-41.
- Swigger, K.M. Brenab, C. and Swigger, B.K. (1983). Behavioural characteristics and their influence on preschool children's selection of programs. *Journal of Computer Based Instruction-24th International ADCIS Conference*, 9 (special issue).
- Tan, L. and Adams, P. (1984). *Computers in early childhood education*. Paper presented at the Australian Computers in Education Conference, Sydney.
- Warash, B. (1984). *Computer language experience approach*. Paper presented at the Annual Meeting of the National Council for Teachers of English, Columbus OH. (ERIC Document No. ED 244 264).
- Williams, A. (1986). A rationale for the use of microcomputers in special education. *The Australian Journal of Special Education*, 10(1), 36-43.
- Williams, R.A. (1984). Preschoolers and the computer. *The Arithmetic Teacher*, 13(8), 39-42.
- Yin, R.K. and Moore, G. B. (1987). The use of advanced technologies in special education: Prospects from robotics, artificial intelligence and computer simulation. *Journal of Learning Disabilities*. 20(1), 60-63.
- Ziajka, A. (1983). Microcomputers in early childhood education. *Young Children*, 38(5), 61-67.

7 APPENDICES

Appendix 1	Pretest
Appendix 2	Posttest
Appendix 3	3.1 Software Used in Study
	3.2 Evaluating Early Childhood Software

Appendix 1 Pretest

Name.....

Date of Test.....

	Question/Instruction to child	Answer	Inference/ Comment
1. Rote Counting	Let's do some counting Can you count for me? Count up to ten for me. If child unable to start indicate by counting three fingers..1,2,3. Record exactly what child says		
2. Recognising Shapes	Show child shapes in the order indicated. Show child a shape from the second set of cards Ask child: Point to the shape that is the same as this shape. Write the name of the shape that the child selects		
3. Naming Shapes	Show child shapes in the order indicated. Ask What is the name of this shape? Write the name that the child says		
4. Counting objects	Count how many "stars" are on this card. Show cards in the order indicated. Record child's answer in next column	7 9 6 2 3 8 1 5 4 10	
5. Counting Jelly Beans	How many jelly beans are there here? Take all jelly beans away before forming new set. Show sets in the order indicated	5 4 10 7 1 6 9 2 3 8	
6. Comparisons	Show child pairs of cards in the order shown in the next column. Ask child: Tell me which card has more "stars" Record child's responses	1 5 3 5 4 2 1 3	
7. Comparisons	Show child groups of jelly beans in the order shown in the next column. Ask child: Tell me which group has more Jelly beans? Record child's responses	5 4 4 2 1 2 5 3	

	Question/Instruction to child	Answer	Inference/ Comment
8. Recognising numerals	Show cards with numeral names one at a time in the following order. For each card ask the child: What number is this? Record child's exact response	4	
		9	
		3	
		2	
		6	
		5	
		8	
		1	
		7	
		10	
9. Recognising numerals	Arrange numeral name cards on the table. Ask child: Find the card with the number "X" on it. Ask numbers in the order indicated in the next column.	2	
		4	
		8	
		7	
		6	
		1	
		10	
		3	
10. Numerals	Make up sets of smarties in the order shown in the next column. Clear each set before making a new set. Ask child to: Point to the number that says how many smarties are in the pile?	9	
		1	
		6	
		2	
		7	
		8	
		3	
		7	

Appendix 2 Posttest

Name.....

Date of Test.....

	Question/Instruction to child	Answer	Inference/ Comment
1. Rote Counting	Let's do some counting....Can you count for me?...Count up to ten for me. If child unable to start indicate by counting three fingers..1,2,3. Record exactly what child says		
2. Recognising Shapes	Place one set of cards on table. Show child a shape from the second set of cards Ask child: Point to the shape that is the same as this shape. Write the name of the shape that the child selects		
3. Naming Shapes	Show child shapes in the order indicated Ask What is the name of this shape? Write the name that the child says		
4. Counting objects	Count how many "stars" are on this card. Show cards in the order indicated. Record child's answer in next column	4 5 1 8 7 9 6 3 10 2	
5. Counting Smarties	How many smarties are there here? Take all smarties away before forming new set. Show sets in the order indicated	8 3 2 9 6 10 4 1 7 5	
6. Comparisons	Show child pairs of cards in the order shown in the next column. Ask child: Tell me which card has more "stars"? Record child's responses	2 4 5 3 4 2 3 6	
7. Comparisons	Show child groups of smarties in the order shown in the next column. Ask child: Tell me which group has more smarties? Record child's responses	3 5 6 4 2 1 4 2	

	Question/Instruction to child	Answer	Inference/ Comment
8. Recognising numerals	Show cards with numeral names one at a time in the following order. For each card ask the child: What number is this? Record child's exact response	5	
		7	
		1	
		10	
		4	
		8	
		6	
		9	
		2	
		3	
9. Recognising numerals	Arrange numeral name cards on the table. Ask child: Find the card with the number "X" on it. Ask numbers in the order indicated in the next column. Record child's exact response	9	
		5	
		10	
		3	
		1	
		6	
		2	
		4	
		8	
		7	
10. Numerals	Make up sets of smarties in the order shown in the next column. Clear each set before making a new set. Ask child to: Point to the number that says how many smarties are in the pile?	2	
		6	
		7	
		8	
		1	
		9	
		3	
		4	
		5	
		10	

Appendix 3.1 Early Childhood Software

Software that supports early language development

Electric Crayon-Fun on the Farm

Polarware

This program is part of the *Sesame Street Crayon* series. It provides a series of pictures featuring farm yard scenes that children colour using an *electronic crayon*. Each picture contains a number of objects that can become the focus for a range of interactive exchanges between teacher/child and child/child. Pictures can be printed in colour with an appropriate printer and a colour ribbon. The *crayon* is controlled via the keyboard, a mouse or a Koala Pad.

Using the crayon via the keyboard involves children in remembering and employing a sequence of steps that involves selecting a crayon, choosing a colour, moving the crayon to the part of the picture to be coloured, and activating the colouring process.

Skills, concepts and processes

identifying animals animal names
matching colour recognition
area/space (especially inside and outside)
sequencing and coordinating actions

Facemaker

Spinnaker Software

Facemaker enables children to put together a variety of faces which can then be animated. It is also possible to sequence the order of animation, such as a winking eye or wiggling ear.

Skills, concepts and processes

ordering events
remembering orderings and sequences
creating a whole from parts
remembering a series of sounds
recognition and naming of colours
identifying and naming parts of the face

Joshua's Reading Machine

Compu-Teach

Joshua's Reading Machine contains nine activities which help children develop vocabulary and word recognition skills by matching word and pictures in the context of familiar rhymes, songs and fables. Most activities involve the substitution of key words in rhymes, songs and fables with pictures. Children then learn to recall, predict, and expect certain words and pictures based on context clues.

Skills, processes and concepts

predicting from context clues
identifying and naming pictures
word recognition
matching words and pictures
recalling and spelling words

Sesame Street Crayon-Opposites Attract
Polarware

This program provides a series of pictures featuring characters from *Sesame Street* that children colour using an *electronic crayon*. Each picture contains a number of "opposites" which can become the focus for a range of interactive exchanges between teacher/child and child/child. Pictures can be printed in colour with an appropriate printer and a colour ribbon. The *crayon* is controlled via the keyboard, a mouse or a Koala Pad.

Skills, concepts and processes

opposites
matching
colour recognition
area/space (especially inside and outside)

Other Language Software

Albert's House (Softime)
Alphabet Circus (DLM)
Animal Rescue (Sherston Software)
Colour and Shape Snap (Educational Software for Microcomputers)
Colour Me (Mindscape)
Exploratory Play (Peal Software)
First Steps with Mr Men (Mirrorsoft)
Gertrude's Secrets (The Learning Company)
Getting Ready to Read and Add (Sunburst)
Hide and Seek (A.S.K. Software)
KinderComp
Learning with Leeper (Sierra on Line)
Magic Slate (Sunburst)
Mouse Paint (Apple Computer)
Muppet Word Book (Sunburst)
Ollie Octopus' Sketchpad (Storm Software)
Podd (Sunburst)
Puzzle Master (Springboard)
Reading and Me (Davidson)
Representational Play (Peal Software)
Seasons and Special Days (Sunburst)
Stickybear Reading (Xerox)
Stickybear Talking Alphabet (Xerox)
The Princess and the Ring (Cambridgeshire)
Tiger Tales Reading Adventure (Sunburst)
Tonk in the Land of Buddy-Bots (Mindscape)
Word Smith (Jacaranda)

Software that supports early mathematics and science development

Charlie Brown 123's Random House

Charlie Brown 123's provides activities to help children recognise numerals, count objects and form sets. The disk is two sided: side 1 has three activities - a number recognition activity, a counting activity and an activity that combines counting and numeral recognition skills. Side 2 has one activity that involves counting and making sets.

<i>Skills, Processes and Concepts</i>	recognition of numerals and words 1-10 counting objects 1-10 forming sets of objects 1-10 counting on one to one correspondence matching sets with numerals
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Color and Shape Rodeo DLM

Color and Shape Rodeo consists of six separate tutorial/drill and practice type activities. Most activities require children to recognise and identify and match shapes. Correct responses are rewarded with animated graphics and sound effects.

<i>Skills, Processes and Concepts</i>	counting objects 1-10 recognition of colours recognition of simple geometric shapes matching shapes same and different one to one correspondence direction finding hidden shapes
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Early Games for Young Children Springboard

This package provides nine games which aim to help children learn about shapes, numbers and letters. One activity is a drawing program.

<i>Skills, processes and concepts</i>	recognising and naming shapes matching shapes same, different attending to attributes of shapes
counting, sets one to one correspondence comparative values of numbers numeral recognition, number names mathematical symbols + - = addition and subtraction of two sets of objects	letter matching, recognition and naming letters combine to make words (writing own name)

Math and Me Davidson

Math and Me provides a series of twelve activities in four areas: shapes, numbers, patterns and addition. Within each area there are three sequential learning activities. *Maths and Me* comes with a useful guide to teaching and learning strategies. Activities can be accessed using a mouse or keyboard.

<i>Skills, processes and concepts</i>	recognising and naming shapes attributes of shapes recognising shapes of common objects matching shapes recognising shapes as abstract forms comparing sizes of familiar shapes same, different, smaller, larger equality
how many, more, less, counting sets, one to one correspondence comparative values of numbers numeral recognition, number names mathematical symbols + = sequences addition of two sets of objects	pattern recognition before, after, between completing patterns sequencing numerals identifying and completing

Number Farm DLM

Number Farm consists of six separate tutorial/drill and practice type activities. Most activities require children to count and match and then select correct responses. Correct responses are rewarded with animated graphics and sound effects.

<i>Skills, Processes and Concepts</i>	recognition of numerals 1-10 counting objects 1-10 forming sets of objects 1-10 counting on one to one correspondence matching sets with numerals recognition and naming of animals
---------------------------------------	---

1-2-3 Sequence Me Sunburst Communications

In this software children are presented with three parts of an event or everyday object which must be ordered correctly. There are three levels within the program. Level one is designed for pre readers. Level 2 combines pictures and text and level three contains text only. The software is accompanied by comprehensive documentation which provides guidelines and support materials for both on computer and off computer activities. Feedback on responses are indicated by TRAX the animated dog. This program can be used with the Muppet Learning Keys.

<i>Skills, processes and concepts</i>	recognition of everyday events and objects sequencing in chronological order vocabulary problem solving comprehension
---------------------------------------	---

Sticky Bear Numbers **Weekly Reader Software**

Sticky Bear Numbers provides one simple to operate activity which enables children to move a self determined set of objects around the screen.

Skills, processes and concepts

Counting
more and less
one to one correspondence
numeral recognition

Other mathematical and scientific software

Amazing Ollie (Storm Software)

Balancing Bear (Sunburst)

Getting Ready to Read and Add (Sunburst)

Muppetville: Identifying and Classifying Shapes and Colours (Sunburst).

Number Detective (Spinifex Software)

Rosie the Counting Rabbit (Collamore Educational Publishing)

Stickybear Opposites (Zerox)

Software that supports across curriculum activities

Exploratory Play (Peal Software)

Gertrude's Secrets (The Learning Company)

Learn about Animals (Sunburst)

LogoWriter (LCSI)

PrintShop and PrintMaster

Representational Play (Peal Software)

Seasons and Special days (Sunburst)

Teddy's Playground (Sunburst)

The Muppet Collection (Sunburst)

The Nature Park Adventure (Sherston Software)

Tonk in the Land of Buddy-Bots (Mindscape)

Zoopak (Jacaranda)

Appendix 3.2 Evaluating Early Childhood Software

Educationally sound	Why would you use this software? Ensure that the learning objectives are easily identifiable and that objectives and content complement your teaching goals and the style of your classroom. Is the learning sequence clear? Does it teach powerful ideas? Does the software emphasise the process of using the software, or the product completed by its use? Is the software about teaching skills? Is it more of a tool? Does it allow hypothesising and discovery learning?
Age appropriateness	Ensure that the software can be easily used by the children for whom it is intended, and that the software reflects a realistic view of presumed knowledge. Does it require good reading ability?
Clear instructions	Are instructions for children simple and precise? Do they use appropriate vocabulary? Are the instructions for teachers clear? Are there appropriate support materials? What sort of materials might you have to make yourself?
Individual differences	Check that the program contains activities of varying degrees of difficulty for children of different abilities. Is child control active or passive? Is the child able to set the pace? Is the child able to leave the program at almost any stage?
Strengths	Identify the apparent strengths and any obvious weakness of the software. Some of these may not be readily apparent until children begin to work with the activity. Determine how much time children need to spend using the software in order to achieve the objectives. Is adult supervision needed? At all times?

Strengths (cont.)

Is the software based on realistic ideas, or is it more fantasy and adventure?

Will this activity replace something or will it complement an existing learning activity? Is the time available? Is it worth it?

Hardware

Be clear about the hardware items needed to operate the program. Make sure that the software is designed for your brand and model of computer. Are additional peripheral devices necessary, for example, a printer, a touch screen?

Does the software make the best use of the technical features of the computer? Is the software colourful and visually stimulating, are there realistic graphics, does it run quickly enough? Is the best use made of sound and music?

Evaluating Computer Based Activities

Evaluating the use of computers in classroom settings involves much more than simply evaluating the software. For example, did the software work in practice, did the children learn, did they enjoy the activity? One possible approach is described below.

When children have participated in the computer activity jot down some information about their responses. Keep these on file for future reference. For example:

How did the children respond to the activity?

Did the activity encourage social interaction?

Did you observe any specific behaviours indicating that

learning took place?

How did you relate this to other curriculum activities?

Was the classroom management effective?

Any other general comments or concerns.